National Advisory Committee for Aeronautics

Research Abstracts

CURRENT NACA REPORTS

NACA Rept. 1132

LAMINAR BOUNDARY LAYER ON CONE IN SUPER-SONIC FLOW AT LARGE ANGLE OF ATTACK. Franklin K. Moore. Appendix B: NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS. Lynn Albers. 1953. ii, 13p. diagrs. (NACA Rept. 1132. Formerly TN 2844)

The laminar boundary-layer flow about a cone at large angles of attack to a supersonic stream has been analyzed in the plane of symmetry. At the bottom of the cone, velocity profiles were obtained showing the expected tendency of the boundary layer to become thinner on the under side of the cone as the angle of attack is increased. At the top of the cone, the analysis failed to yield unique solutions, except for small angle of attack. Beyond a certain critical angle of attack, boundary-layer flow does not exist in the plane of symmetry, thus indicating separation.

NACA Rept. 1139

CHARTS AND APPROXIMATE FORMULAS FOR THE ESTIMATION OF AEROELASTIC EFFECTS ON THE LATERAL CONTROL OF SWEPT AND UNSWEPT WINGS. Kenneth A. Foss and Franklin W. Diederich. 1953. iii, 25p. diagrs., 2 tabs. (NACA Rept. 1139. Formerly TN 2747)

Charts and approximate formulas are presented for the estimation of static aeroelastic effects on the spanwise lift distribution, rolling-moment coefficient, and rate of roll due to aileron deflections on swept and unswept wings at subsonic and supersonic speeds. Some design considerations brought out by the results of this paper are discussed.

NACA Rept. 1148

A SPECIAL INVESTIGATION TO DEVELOP A GENERAL METHOD FOR THREE-DIMENSIONAL PHOTOELASTIC STRESS ANALYSIS. M. M. Frocht and R. Guernsey, Jr., Illinois Institute of Technology. 1953. ii, 17p. diagrs., photos., 3 tabs. (NACA Rept. 1148. Formerly TN 2822)

The method of strain measurement after annealing is reviewed and found to be unsatisfactory for the materials available in this country. A new, general method is described for the photoelastic determination of the principal stresses at any point of a general body subjected to arbitrary loads. The method has been applied to a sphere subjected to diametral compressive loads. The results show possibilities of high accuracy.
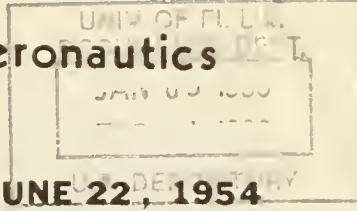
NACA RM 54D19

PRELIMINARY MEASUREMENTS OF TURBULENCE AND TEMPERATURE FLUCTUATIONS BEHIND A HEATED GRID. A. L. Kistler, V. O'Brien and S. Corrsin, Johns Hopkins University. June 1954. 24p. diagrs., photo. (NACA RM 54D19)

Preliminary measurements have been made of velocity and temperature fluctuations in the flow behind a heated grid in a uniform air stream. Temperature correlation shows a reasonable degree of isotropy, and the temperature fluctuations die out at large distances more slowly than the turbulence, as has been predicted theoretically under some strongly simplifying postulates.

NACA TN 3072

A THEORETICAL INVESTIGATION OF THE AERO-DYNAMICS OF WING-TAIL COMBINATIONS PER-FORMING TIME-DEPENDENT MOTIONS AT SUPERSONIC SPEEDS. John C. Martin, Margaret S. Diederich and Percy J. Bobbitt. May 1954. 226p. diagrs., tab. (NACA TN 3072)

A theoretical investigation is presented on the contribution of the horizontal tail to the lift and pitching moment due to angle of attack, a constant rate of pitch, and a constant vertical acceleration. Numerical values of the aerodynamic coefficients associated with these motions are presented for a number of two-dimensional wing-tail combinations, a triangular-wing—triangular-tail combination, and a number of rectangular-wing—triangular-tail combinations. A method of treating unsteady aerodynamics based on an infinite series of stability derivatives of successively higher order is presented. Methods for calculating the flow fields behind wings with a constant vertical acceleration are developed. Calculated results are presented for the upwash behind two-dimensional wings and for certain regions behind triangular and rectangular wings for a constant rate of pitch and for a constant rate of vertical acceleration.

NACA TN 3150

METHOD FOR RAPID DETERMINATION OF PRES-SURE CHANGE FOR ONE-DIMENSIONAL FLOW WITH HEAT TRANSFER, FRICTION, ROTATION, AND AREA CHANGE. James E. Hubbartt, Henry O. Slone and Vernon L. Arne. June 1954. 22p. diagrs., 2 tabs. (NACA TN 3150)

An approximate method for rapid determination of the pressure change for subsonic flow of a compressible fluid under the simultaneous action of heat transfer, friction, rotation, and area change is developed. In the development of this method, the momentum equation was approximated and re-

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arranged for a convenient solution employing charts. This report presents the analysis involved in simplifying the momentum equation, the charts necessary for obtaining particular solutions, and comparisons with more rigorous numerical solutions with conditions typical for air-cooled turbine blades.

NACA TN 3174

INFLUENCE OF AIRFOIL TRAILING-EDGE ANGLE AND TRAILING-EDGE-THICKNESS VARIATION ON THE EFFECTIVENESS OF A PLAIN FLAP AT HIGH SUBSONIC MACH NUMBERS. Albert D. Hemenover and Donald J. Graham. June 1954. 101p. diagrs., photos., 5 tabs. (NACA TN 3174. Formerly RM A51C12a)

The effects of variation of trailing-edge angle and trailing-edge thickness on the characteristics of a 10-percent-chord thick NACA airfoil section with a 25-percent-chord plain flap are appraised from wind-tunnel tests at Mach numbers from 0.3 to 0.9 and Reynolds numbers varying correspondingly from 1 to 2 million. The airfoil trailing-edge angle was varied from 18° to 6°, and the trailing-edge thickness from zero to the thickness at the flap hinge line.

NACA TN 3207

ROLE OF NICKEL DIP IN ENAMELING OF SHEET STEEL. D. G. Moore, J. W. Pitts and W. N. Harrison, National Bureau of Standards. June 1954. 27p. diagrs., photos., 8 tabs. (NACA TN 3207)

An investigation was made of the effects of the firing time and the weight of the nickel deposited from the nickel-dip solution on the adherence developed by a cobalt-free and a cobalt-bearing ground-coat enamel on both enameling iron and a titanium-bearing low-carbon steel.

NACA TN 3215

TESTS OF BONDED AND RIVETED SHEET-STRINGER PANELS. Leonard Mordfin and I. E. Wilks, National Bureau of Standards. June 1954. 45p. diagrs., photos., 5 tabs. (NACA TN 3215)

Bending and compression tests were performed on 21 sheet-stringer panels of 75S-T6 aluminum alloy having alclad sheets nominally 0.051 inch thick and stringers nominally 3-1/2 inches apart. Nine panels had I-stringers bonded to the sheets with Araldite Type I adhesive, three panels had I-stringers bonded to the sheets with Metlbond adhesive, and nine panels had Z-stringers riveted to the sheets. All tests were carried to failure and strain and deformation measurements were made. The test results did not indicate any great superiority of one type of construction over the other but rather that the choice in any given case would depend upon the particular designs being compared. They also showed that the scatter of results obtained with bonded construction was not significantly greater than that obtained with riveted construction and that cleavage was not always the governing factor in the strength of bonded panels.

BRITISH REPORTS

N-30793*

Royal Aircraft Establishment (Gt. Brit.) A HIGH SPEED ELECTRO-MECHANICAL MULTIPLIER. C. A. A. Wass and D. W. Allen. February 1954. 13p. diagrs., photos. (RAE Tech.Note GW 300)

Requirements exist in simulator work for a simple high-speed squaring and multiplying unit of moderate accuracy. This note describes a simple electro-mechanical multiplier using a type E.4 relay as a position servo driving a potentiometer. The unit will operate on frequencies up to 15 cps without introducing any appreciable phase shift. Accuracy depends primarily on the quality of the potentiometers used but maximum errors of 1 percent of the maximum output appear possible.

N-30835*

Royal Aircraft Establishment (Gt. Brit.) A NOTE ON THE USE OF STRAIN GAUGES IN WIND TUNNEL BALANCES. J. R. Anderson. January 1954. 28p. diagrs., photos. (RAE Tech.Note Aero 2290)

This note is substantially that presented at the NATO/AGARD wind tunnel and model testing panel on September 3, 1953. It reviews briefly some of the experience obtained in the employment of wind-tunnel balances using bonded, resistance type electrical strain gages, in the smaller high-speed wind tunnels of Aerodynamics Department. The effects of temperature on the strain gages are discussed and shown to be a major limitation in their use. A self-balancing potentiometer instrument, specially designed and developed for use with wind-tunnel strain-gage balances, is also described briefly.

N-30837*

Marine Aircraft Experimental Establishment (Gt. Brit.) THE DEVELOPMENT OF A MINIATURE PRESSURE PICK-UP. J. K. Friswell. March 1954. 10p. diagrs., photos. (MAEE F/TN/3)

Details are given of the construction of a miniature pressure pickup of the diaphragm and strain-gaged cantilever type. The unit is cylindrical, with overall diameter 1 inch and overall length 2 inches, its weight being 1.9 ounces. It is designed to operate in the range 0-20 psi and will record either positive or negative pressures. It can be readily adapted for use over a much greater pressure range. It is easy to service.

N-30839*

Marine Aircraft Experimental Establishment
(Gt. Brit.) ASSESSMENT OF REVERSIBLE PITCH
PROPELLER TRAIL INSTALLATION - SOLENT
N. J. 201. J. Taylor. March 1954. 23p. diagrs.,
photos., 2 tabs. (MAEE F/TN/2)

An assessment was required on the operation of the
reversible pitch propeller trial installation, on the
Solent N. J. 201, as part of a general research pro-
gram for seaplanes. Results are given with the
reversing pitch propellers fitted to the inboard
engines in tests on low speed maneuvering, partic-
ularly in buoy approaches, and when used as braking
units during landing. Some brief turning circle
measurements have also been done.

N-30843*

Aeronautical Research Council (Gt. Brit.)
THE PERFORMANCE OF THE 108 COMPRESSOR
FITTED WITH LOW STAGGER FREE VORTEX
BLADING. D. V. Foster. 1954. 36p. diagrs.,
photos. (ARC CP 144)

A large three-stage compressor is described which
is designed for detail three-dimensional flow inves-
tigations. Particular attention has been paid to the
accuracy of measurement on the rig and it is shown
that the main errors are due to the unsteady nature
of the flow and to speed fluctuations. Test charac-
teristics of the first set of low stagger free vortex
blading are presented and compared with various
theoretical performance calculations. A description
of the surging behavior of the compressor and the
effect of blade position upon the measured static
pressure are given.

N-30844*

Aeronautical Research Council (Gt. Brit.)
ZERO LIFT DRAG MEASUREMENTS ON SWEPT
WINGS AT TRANSONIC AND SUPERSONIC SPEEDS
USING THE GROUND-LAUNCHED ROCKET-
BOOSTED MODEL TECHNIQUE. T. Lawrence and
C. Kell. 1954. 35p. diagrs., photo., tab. (ARC
CP 145)

This is mainly a documentary record of drag meas-
urements on 14 swept wings varying in plan form
from deltas to swept untapered wings from 4 percent
to 10 percent thick. Results are compared with
theory for wings of double-wedge section; an attempt
is made to check the validity of supersonic similarity
laws. Three primary conclusions are drawn; at
supersonic speeds, wave drag of a given wing varies
as the square of thickness ratio; supersonic similar-
ity law allows drag of "similar" wings to be com-
pared; drag of round-nose wings perhaps may be
estimated from calculations of drag of double-wedge
wings.

N-30845*

Aeronautical Research Council (Gt. Brit.)
VIBRATION AND FLUTTER OF AIRCRAFT
AERIALS. W. H. Johnson. 1954. 15p. diagrs.,
photos. (ARC CP 146)

Fatigue failures of blade and whip aircraft aerials
have been investigated and it is shown that stalling
flutter and mechanically excited vibration have both
contributed in large measure to the failures. All the
aerial types involved possess considerable flexibility
and very low internal damping. It is shown that the
introduction of damping into the mounting of the
aerials has a very beneficial effect on their behavior
as regards both flutter and mechanically excited
vibration. Methods are described for preventing
failure from either cause.

N-30846*

Aeronautical Research Council (Gt. Brit.)
FACTORS INFLUENCING THE OPTIMUM AERO-
DYNAMIC DESIGN OF COOLED TURBINES.
G. F. C. Rogers. 1954. 27p. diagrs. (ARC
CP 155)

Owing to the losses in performance which increase
with the rate of heat extraction required for turbine
cooling, it is desirable to know what range of aero-
dynamic designs is associated with low values of this
quantity. Different aerodynamic designs of turbine,
all passing the same mass flow and having approxi-
mately the same disc and blade stresses, have been
compared on the basis of the ratio of heat extraction
rate to work output. It is found that high values of
flow coefficient are beneficial in this respect, and
that impulse turbines have a slight advantage over
reaction turbines.

N-30847*

Aeronautical Research Council (Gt. Brit.)
THE EFFECT OF ROLLING ON FIN-AND-RUDDER
LOADS IN YAWING MANOEUVRES. D. R. Puttock.
1954. 31p. diagrs., 3 tabs. (ARC CP 153)

Exact solutions are derived for angle of sideslip and
fin-and-rudder loads for an aircraft performing two
yawing maneuvers induced by the rudder. Angles of
sideslip and fin-and-rudder loads are then calculated
for three selected aircraft and compared with results
obtained by a simplified method in which rolling
motion is neglected. Further calculations are made
using a modified method in which the coefficients of
the response formulas of the simplified method have
been adjusted to take some account of rolling. The
analysis shows that errors of 20 percent may be
incurred if rolling is neglected in the estimation of
fin-and-rudder loads for aircraft with swept and
delta wings.

N-30895*

Royal Aircraft Establishment (Gt. Brit.)
SECONDARY FLOW IN A BOUNDARY LAYER. L.
Sowerby. March 1954. 21p. diagrs., tab. (RAE
Aero 2512)

The laminar boundary layer on a flat plate is con-
sidered. It is shown that a secondary flow in the
boundary layer is a consequence of curvature in the
streamlines of the mainstream flow (in planes paral-
lel to the plate). The special case in which the
streamlines form a family of translates is discussed
and the equations of possible families of streamlines
are determined. The boundary-layer equations are
solved in the case where the streamlines are a
family of equal parabolas; this leads to an extension
of Blasius' result for uniform flow over a flat plate.
Finally, in the appendix, the skin friction coefficient
is calculated, from which is obtained a quantity anal-
ogous to the profile-drag coefficient of a swept wing,
for comparison with the results of Weber and Brebner
for the latter case. The comparison confirms the
assumptions made by them in the development of
their theory.

N-30898*

Royal Aircraft Establishment (Gt. Brit.)
NOTES ON THE RESPONSE OF A LINEAR VIBRA-
TION SYSTEM TO IMPACT LOADING. H. K. P.
Neubert. March 1954. 21p. diagrs. (RAE Tech.
Note Instn. 138)

In the course of investigations into the effect of im-
pact loadings, the general equations for deflection,
velocity, and acceleration of a linear system of one
degree of freedom with velocity damping have been
derived for a case of a mass being dropped onto a
spring (with negligible mass). Response curves are
plotted and discussed for two idealized cases of air-
craft landing, and for a drop table test. The possible
errors for a proposed integrating touch-down velocity
meter are discussed. Frequency spectra for three
typical impact curves have been computed and the
error introduced when measuring the impact with an
accelerometer of inadequate frequency response is
discussed.

MISCELLANEOUS

NACA Rept. 1028

Errata No. 1 on "EFFECT OF ASPECT RATIO ON
THE AIR FORCES AND MOMENTS OF HARMON-
ICALLY OSCILLATING THIN RECTANGULAR
WINGS IN SUPERSONIC POTENTIAL FLOW."
Charles E. Watkins. 1951.

UNPUBLISHED PAPERS

N-1726*

ON SEVERAL MEASURES, TAKEN IN PRACTICE,
FOR ELIMINATING OSCILLATORY YAW WITH
FREE RUDDER. (Über einige praktisch
durchgeführte Massnahmen zur Beseitigung von
Gierschwingungen mit losem Ruder). R. Schmidt.
April 1954. 10p. diagrs., photo. (Trans. from
Lilienthal-Gesellschaft für Luftfahrtforschung,
Berlin, Bericht 143, Nov. 6-7, 1941, p. 22-24)

Measures, tested and carried out on several air-
planes at Dornier works when unsatisfactorily
damped oscillatory yaw had occured, and its elim-
ination by modifications of the tail had not been pos-
sible, are discussed. The two groups of measures
discussed are measures which augment the increase
of rudder moment in the region of zero position of
the controls; and measures which impede the free
motion relative to the air of the rudder.

N-31386*

MEASURES FOR ELIMINATION OF OSCILLATORY
YAW WITH FREE RUDDER. (Massnahmen zur
Beseitigung von Gierschwingungen mit losem
Seitenruder). H. G. Schumann. April 1954. 6p.
diagrs. (Trans. from Lilienthal-Gesellschaft für
Luftfahrtforschung, Berlin, Bericht 143, Nov. 6-7,
1941, p. 27-29)

Experiences are given which were made with the
Ju 88 in controlling oscillatory yaw with free rudder.
This method of attaining the degree of rudder load
reduction required in the individual case by the con-
trol force itself, involved the return to harmless
variations of rudder-self-adjustment and eliminated
thus for a long time the difficulties occurring now
and again at other firms.

N-31449*

THEORETICAL AND EXPERIMENTAL STUDY OF
THE MEANS OF PROTECTING AN AIRPLANE
FROM GUST ACCELERATIONS. CHAPTER VIII -
EXPERIMENTAL STUDY. (Recherches théoriques
et expérimentales sur les moyens de soustraire un
avion aux accélérations que peuvent engendrer les
perturbations atmosphériques. Chapitre VIII -
Étude expérimentale). René Hirsch. February
1954. 45p. diagrs., photos. (Trans. from
Ministère de l'Air. Publications Scientifiques et
Techniques, no. 138, 1938)

Changes in direction and intensity of the relative
wind which strikes the airplane in flight induce
changes in the total hinge moment of the controlled
aileron so that the consecutive rotations of the latter
produce exactly defined variations of the total lift
coefficient. Two basic airfoils were studied, the
Potez 403 and NACA 23012.